Addition: Partial Sums

Many times it is easier to break apart addends. Often it makes sense to break them apart by their place value. Consider 248 + 345

248 = 200 + 40 + 8
345 = 300 + 40 + 5
500 + 80 + 13 = 593

Sometimes we might use partial sums in different ways to make an easier problem. Consider 484 + 276

484 = 400 + 84
276 = 260 + 16
660 + 100 = 760

Addition: Adjusting

We can adjust addends to make them easier to work with. We can adjust by giving a value from one addend to another. Consider 326 + 274. We can take 1 from 326 and give it to 274.

326 + 274
-1 +1

More Friendly Problem → 325 + 275 = 600

Consider 173 + 389. We can take 27 from 389 and give it to 173 to make 200.

173 + 389
+ 27 -27

More Friendly Problem → 200 + 362 = 562

Addition: Traditional Algorithm

This algorithm is useful for adding large numbers. We add place values and regroup when needed.

```
  1 1
 13,089
+ 4,684
 17,773
```

Subtraction: Count Up or Count Back

When subtracting, we can count back to find the difference of 2 numbers. In many situations, it is easier to count up. Consider 536 – 179.

Counting Up

179 + 21 = 200
200 + 300 = 500
500 + 36 = **536**

The total of our **counting up** is 357.
So, 536 – 179 = 357

Counting Back

536 - 36 = 500
500 - 300 = 200
200 - 21 = **179**
(-) 357

The total of our **counting back** is 357.
So, 536 – 179 = 357

Subtraction: Adjusting

We can use "friendlier numbers" to solve problems. 4,000 – 563 can be challenging to regroup. But the difference between these numbers is the same as the difference between 3,999 – 562. Now, we don't need to regroup.

(Original problem)	**4,000**	-	**563 =**
(Compensation)	- 1		- 1
	3,999	-	562 = 3,437

Subtraction: Traditional Algorithm

This algorithm is useful for subtracting large numbers. We regroup when necessary.

```
     8 1
 14,290
- 3,236
 11,054
```

Multiplication: Partial Products

Students move from area/array models to working with numbers.

Consider 26 x 45, we can break apart each factor by its place value.

26 = (20 + 6)
45 = (40 + 5)

We can then multiply each of the "parts" and add them back together.

(20 x 40) + (20 x 5) + (40 x 6) + (6 x 5)
800 + 100 + 240 + 30
900 + 240 + 30
1,140 + 30
1,170

So, 26 x 45 = 1,170

It might seem like a lot of numbers above. But, when we think about it, the multiplication is quite simple. This understanding develops mental math, the traditional algorithm, and algebraic concepts including factoring polynomials.

Sometimes, it makes sense to work with different parts. Consider 51 x 21. We might think of 21 as 10 + 10 + 1:

(51 x 10) + (51 x 10) + (51 x 1)
510 + 510 + 51
1,020 + 51
1,071

So, 51 x 21 = 1,071

Another example, consider 4 x 327. We can break 327 into (300 + 20 + 7) then multiply.

```
  4 x 300 = 1,200
  4 x 20  =    80
+ 4 x 7   =    28
            1,308
```

So, 4 x 327 = 1,308

Multiplication: Partial Products Algorithm

In this algorithm, we break apart the numbers by place value to find parts of the product. We add them back together to get the final product. This algorithm begins in the **ones** place.

48		
x 32		
16	←	(2 x 8)
80	←	(2 x 40)
240	←	(30 x 8)
+ 1200	←	(30 x 40)
1,536		

Multiplication: Partial Products Algorithm

In this algorithm, we break apart the numbers by place value to find parts of the product. We add them back together to get the final product. This algorithm begins in the **tens** place.

48		
x 32		
1200	←	(40 x 30)
240	←	(30 x 8)
80	←	(40 x 2)
+ 16	←	(8 x 2)
1,536		

Multiplication: Traditional Algorithm

This is a digit-based algorithm. It is useful for multiplying large numbers. We begin in the ones place and proceed to multiply each digit. We combine products of each place value.

48		
x 32		
96	←	(2 x 8) + (2 x 40)
+ 1440	←	(30 x 8) + (30 x 40)
1,536		

Division*

5th grade students continue to develop an understanding of division with larger numbers. One approach is to take groups of numbers, usually "friendly numbers" out.

Consider this:
We have 252 buttons to put in 4 boxes. How many buttons can we put in each box? (252 ÷ 4)

We can put 50 in each box (4 x 50) = 200
We can put 10 in each box (4 x 10) = 40
We can put 3 in each box (4 x 3) = 12
63 252

So, we can put 63 buttons in each box.
252 ÷ 4 = 63

Another approach is to break apart the dividend into "friendly numbers." Consider 252 ÷ 4. We could break 252 into (240 + 12) and divide each by 4.

240 ÷ 4 = 60	60 + 3 = 63
12 ÷ 4 = 3	So, 252 ÷ 4 = 63

We may also consider Think Multiplication to work with division. Consider 932 ÷ 45.

We can think of "What times 45 equals 932?"

We might think 45 x 10 = 450, so…
45 x 20 = 900

20 groups of 45 is 900. We have 32 leftover but that is not enough for another group.

932 ÷ 45 = 20 with 32 leftover.

* The long division algorithm is introduced in grade 6 after students develop deep understanding of grouping and division.

Developing Computational Fluency

Grade 5

Elementary Mathematics Office
Howard County Public School System

This brochure highlights some of the methods for developing computational fluency. For more information about computation and elementary mathematics visit http://smart.wikispaces.hcpss.org